

Exhibit 4

LG – Mobile Device (Smartphones and Tablets models with IR Time-of-Flight sensor/camera to support Gesture Recognition such as Air Motion, Face ID, Hand ID, and/or Gesture Shot features. See Product List at end for models)

Infringement of the '112 patent

Claim 1

1. A method of measuring the magnitude of electromagnetic radiation in a selected location by a mobile communication device, comprising the steps of:

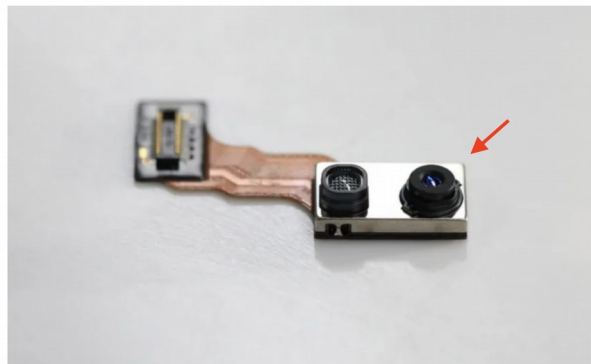
Evidence

The LG mobile device performs a method of measuring the magnitude of electromagnetic radiation in a selected location.

For example, when gesture recognition features such as Air Motion, Face ID, Hand ID, and/or Gesture Shot of the mobile device are used, the mobile device measures the magnitude and time delay of infrared electromagnetic radiation received by the mobile device's Time-of-Flight sensor at the location at which the front-facing camera is aimed.

LG explains how the G8 ThinQ's tiny gesture sensor works

It could also work in a car to control your AC and GPS with hand gestures.



LG

[1]



Steve Dent | @stevetdent | February 20, 2019 8:41 AM

LG has revealed more details about the "Time of Flight" sensor that will likely power the [G8 ThinQ's touchless gestures](#). Built by LG's Innotek division, it reflects infrared light off of a subject, measures how long it takes to return and uses the data to calculate depth. LG said that the tech works over "long" distances, while consuming less power than other 3D tech. As such, it's suitable for face detection ID tech, motion sensing, AR, and more.

It differs from Apple's TrueDepth Face ID tech, which beams thousands of laser dots at a subject, then measures the distortion to calculate depth. Time of Flight, by contrast, measures distances like radar, and is similar to what Microsoft used in its [Xbox One Kinect](#). It can, in theory, deliver more accurate results for biometric scans, augmented reality and more.

[1]

LG G Pad 7.0^{LTE}

press a volume key to take a photo 

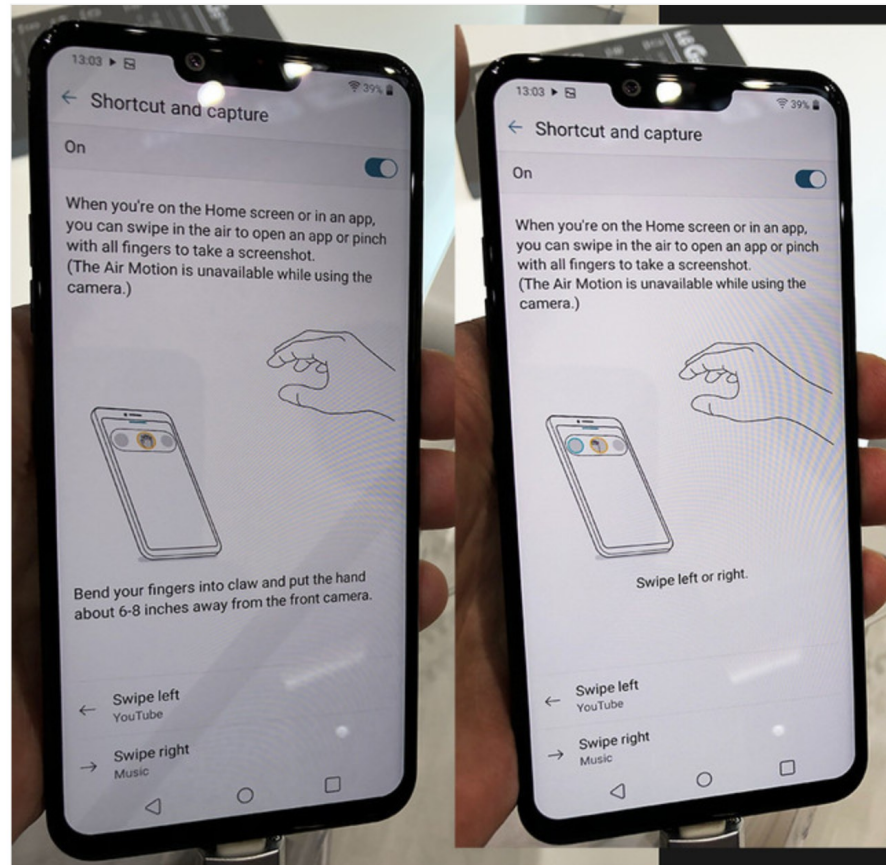
- Gesture Shutter² – take selfies with a simple hand gesture
- Image Editor – choose from multiple options to enhance your photos such as adding filters and frames, adjusting contrast and brightness, and more
- Video Resolutions: full HD up to 1920 x 1080¹
- Pause & Resume Recording – pause and start in record mode for one continuous video file
- Live Shot – take still shots while recording video
- Live Zooming – zoom in/out on videos during playback
- Geotagging – include location information with photos and videos

¹ Available only on rear-facing camera or camcorder.

² Available only on front-facing camera or camcorder. 

[3]

Another use is "Hand ID". Everyone has a distinctive hand and hand movements, LG said, and can differentiate between users, since the ToF sensor is mapping your veins. Hmm, you may be thinking. As I did.



LG AirMotion UI. Click to enlarge

[4]

	<p><u>The "Air Motion" UI, which found in its new V50 ThinQ 5G and LG G8, requires you to draw shapes with your hand over the phone. It was like playing an invisible theremin. But it was hard to master and unreliable.</u></p> <p>The phones use Infineon's "time-of-flight" (ToF) 3D sensor, <u>unveiled</u> a couple of weeks ago and technically <u>very interesting</u>.</p> <p>[4]</p>
providing a mobile communication device that comprises an enclosure, a digital imaging sensor having a first field of view, such sensor is for generating a digital image of the selected location,	<p>The LG mobile device further provides a mobile communication device that comprises an enclosure and a digital imaging sensor that has a first field of view. The sensor is for generating a digital image of the selected location.</p> <p>For example, the mobile device includes an enclosure for housing a digital image sensor, among other components of the mobile device. The digital image sensor has a field of view (e.g. outwards from the front of the mobile device) and is for generating a digital image of a subject or location at which it is aimed.</p> <p>For example, the LG G8 ThinQ has 8.1 MP CMOS image sensor (front facing camera) within an enclosure, which is also referred to herein as a housing.</p>

LG LMG820QM5 G8 ThinQ TD-LTE US
G820QM / LMG820QM7D (LG Alpha Prime)



[2]

Secondary Camera System ①

Secondary Camera Placement ①	Front
Secondary Camera Sensor ①	CMOS ①
Secondary Camera Number of pixels ①	8.1 MP sec. cam
Secondary Aperture (W) ①	f/1.90
Secondary Camera Focus ①	PD AF ①
Secondary Video Recording ①	1920x1080 pixel 30 fps ①
Secondary Camera Extra Functions ①	Burst mode , Panorama Photo , Face detection
Sec. Aux. Cam. Image Sensor ①	Mono CMOS ①

[2]

For example, the LG GPAD 7.0 LTE tablet has 1.3 MP CMOS image sensor (front facing camera) within an enclosure, which is also referred to herein as a housing.



[3]

Camera/Video ←

- 5 Megapixel Rear-Facing Camera
- 1.3 Megapixel Front-Facing Camera with Soft Light Setting
- Camera Resolutions: up to 2560 x 1920¹ (2560 x 1600 default)
- Shot Mode – choose from Panorama¹ and Auto
- Timer – set shutter/record delay to 3 or 10 seconds
- Zoom¹ – up to 4x
- Multiple Shutter Options – tap the shutter, use your voice, or

[3]





a computer,

The LG mobile device further provides a computer.

For example, the CPU device includes a main processor for performing computational processing.

For example, the LG G8 ThinQ smartphone includes a Qualcomm Snapdragon CPU device:

	<p>📱 Application processor, Chipset:</p> <p>CPU Clock ① 2842 MHz</p> <p>CPU ① Qualcomm Snapdragon 855 SM8150 (Hana),</p> <p>📱 Operative Memory:</p> <p>RAM Type ① LPDDR4x SDRAM</p> <p>2133 MHz ①</p> <p>RAM Capacity (converted) ① 6 GiB RAM</p> <p>[2]</p> <p>For example the LG GPAD 7.0 LTE tablet includes a Qualcomm Snapdragon CPU device:</p> <div data-bbox="638 696 1276 1136"> <p>Key Features</p> <p>Vivid 7.0" HD+ IPS Display (1280 x 800)</p> <p>5 MP Camera</p> <p>Qualcomm® Snapdragon™ 400 1.2 GHz Quad-Core Processor</p> <p>Long-Lasting 4,000 mAh Battery</p> <p>QPair™ Links to Android™ Smartphones for Tandem Use*</p> </div> <p>[3]</p>
and an output component for conveying information to an operator;	<p>The LG mobile device further provides an output component for conveying information to an operator.</p> <p>For example, the mobile device also includes a touchscreen display for conveying information to an operator.</p>

	<p>For example, the LG G8 ThinQ includes an AM-OLED touchscreen display:</p> <p>❖ Display ① </p> <table border="1"> <tr> <td>Display Notch ①</td><td>1-notch</td></tr> <tr> <td>Display Diagonal ①</td><td>154.6 mm 6.1 inch ①</td></tr> <tr> <td>Resolution ①</td><td>1440x3120</td></tr> <tr> <td>Horizontal Full Bezel Width ①</td><td>7.01 mm</td></tr> <tr> <td>Display Area Utilization ①</td><td>83.4% </td></tr> <tr> <td>Pixel Density ①</td><td>565 PPI</td></tr> <tr> <td>Display Type ①</td><td>AM-OLED ① display</td></tr> <tr> <td>Number of Display Scales ①</td><td>1073.7M</td></tr> <tr> <td>Scratch Resistant Screen ①</td><td>Gorilla Glass 5</td></tr> </table> <p>[2]</p> <p>For example the LG GPAD 7.0 LTE tablet includes a 7.0" HD+ IPS display:</p> <p>Interactivity</p> <ul style="list-style-type: none"> • 7.0" HD+ IPS Display with Gorilla® Glass 3 Protection • QuickRemote™ – control compatible TVs and cable provider set-top boxes • Smart Screen – display setting keeps the screen active when tablet detects a face • Video Player with Touch Lock and Resume Play Function; supports MP4, H.263, H.264, VC-1, WMV, DivX, VP8, Theora • Music Player with Sleep Timer and Custom Audio Effects; supports MP3, AAC, eAAC+, WAV, WMA/WMV, FLAC <p>[3]</p>	Display Notch ①	1-notch	Display Diagonal ①	154.6 mm 6.1 inch ①	Resolution ①	1440x3120	Horizontal Full Bezel Width ①	7.01 mm	Display Area Utilization ①	83.4% 	Pixel Density ①	565 PPI	Display Type ①	AM-OLED ① display	Number of Display Scales ①	1073.7M	Scratch Resistant Screen ①	Gorilla Glass 5
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Display Type ①	AM-OLED ① display																		
Number of Display Scales ①	1073.7M																		
Scratch Resistant Screen ①	Gorilla Glass 5																		
coupling to the enclosure a module that is responsive to intensity of the electromagnetic radiation in a selected spectral range;	<p>During manufacturing of the mobile device, LG couples to the enclosure a module that is responsive to intensity of the electromagnetic radiation in a selected spectral range.</p> <p>For example, the time-of-flight sensor in the mobile device is responsive to electromagnetic radiation in the infrared range and is coupled to the mobile</p>																		

device's enclosure.

LG has been having a low-key Mobile World Congress, but its most eye-catching feature has been an attempt to implement waving your hands about as a method of interacting with its smartphone. It was immediately apparent why this hasn't come to market earlier.

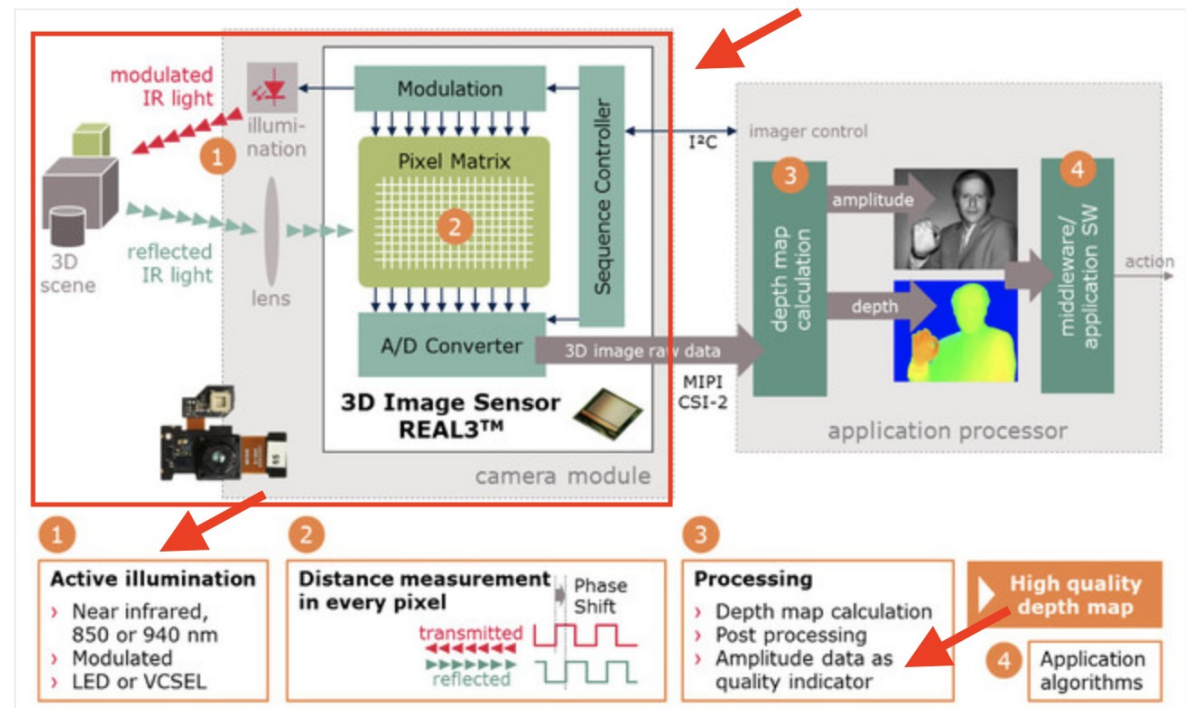
The "Air Motion" UI, which found in its new V50 ThinQ 5G and LG G8, requires you to draw shapes with your hand over the phone. It was like playing an invisible theremin. But it was hard to master and unreliable.

The phones use Infineon's "time-of-flight" (ToF) 3D sensor, unveiled a couple of weeks ago and technically very interesting.

[4]

At first glance, the G8 ThinQ looks a lot like the [G7 ThinQ](#), but there's more to their similar metal and glass constructions. Housed inside of the notch is a new camera sensor that recognizes hand gesture and can be used to control features like the volume, calls, and media playback.

[5]



Infineon's Time of Flight 3D Sensor. Click to enlarge

[4]

LG G Pad 7.0^{LTE}

press a volume key to take a photo 

- Gesture Shutter² – take selfies with a simple hand gesture
- Image Editor – choose from multiple options to enhance your photos such as adding filters and frames, adjusting contrast and brightness, and more
- Video Resolutions: full HD up to 1920 x 1080¹
- Pause & Resume Recording – pause and start in record mode for one continuous video file
- Live Shot – take still shots while recording video
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- Geotagging – include location information with photos and videos

¹ Available only on rear-facing camera or camcorder.

² Available only on front-facing camera or camcorder. 

[3]

enabling positioning the enclosure in a vicinity of the selected location;

The LG mobile device enables positioning the enclosure in a vicinity of the selected location.

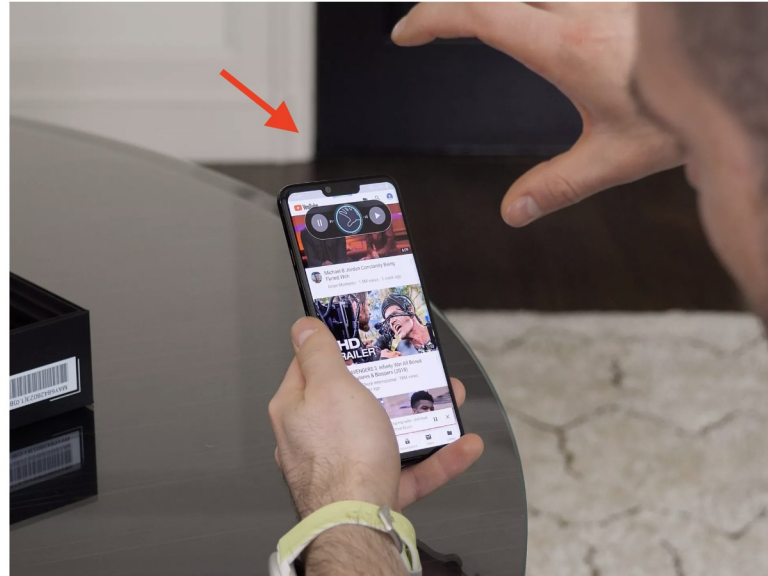
For example, the mobile device is handheld and mobile, therefore the enclosure can be positioned in the vicinity of the selected location e.g. a user's face and hand when gesture recognition features such as Air Motion, Face ID, Hand ID, and/or Gesture Shot are used.

For example, when using the Air Motion feature, the LG G8 ThinQ smartphone is positioned with the front camera facing, and about 5" away

from, the user's hand that is making gestures.

How to use Air Motion on the LG G8

By Hayato Huseman published April 12, 2019



LG G8 Air Motion gestures (Image credit: Android Central)

[6]

The G8's handy new Time of Flight sensor and infrared light within the Z Camera system allow for what LG calls Air Motion — essentially a handful of gesture-based controls that let you quickly jump into app shortcuts, control music playback, and take screenshots, all without having to touch the phone. Here's how to make the most of it.

[6]

With Air Motion enabled, you can launch it by holding your hand about 3-5 inches away from the Z Camera sensors. You'll see a colorful line appear under the display notch, indicating Air Motion has been activated. From there, bring your fingers closer together to **form a claw-like shape** — if you have it enabled, the hand guide will appear, tracking your fingers and awaiting your gestures.

[6]

For example, when using the Gesture Shot/Shutter feature, the LG GPAD 7.0 LTE tablet is positioned with the front camera facing, and close to, the user's hand that is making gestures.



Gesture shot


The Gesture shot feature allows you to take a picture with a hand gesture using the front camera.

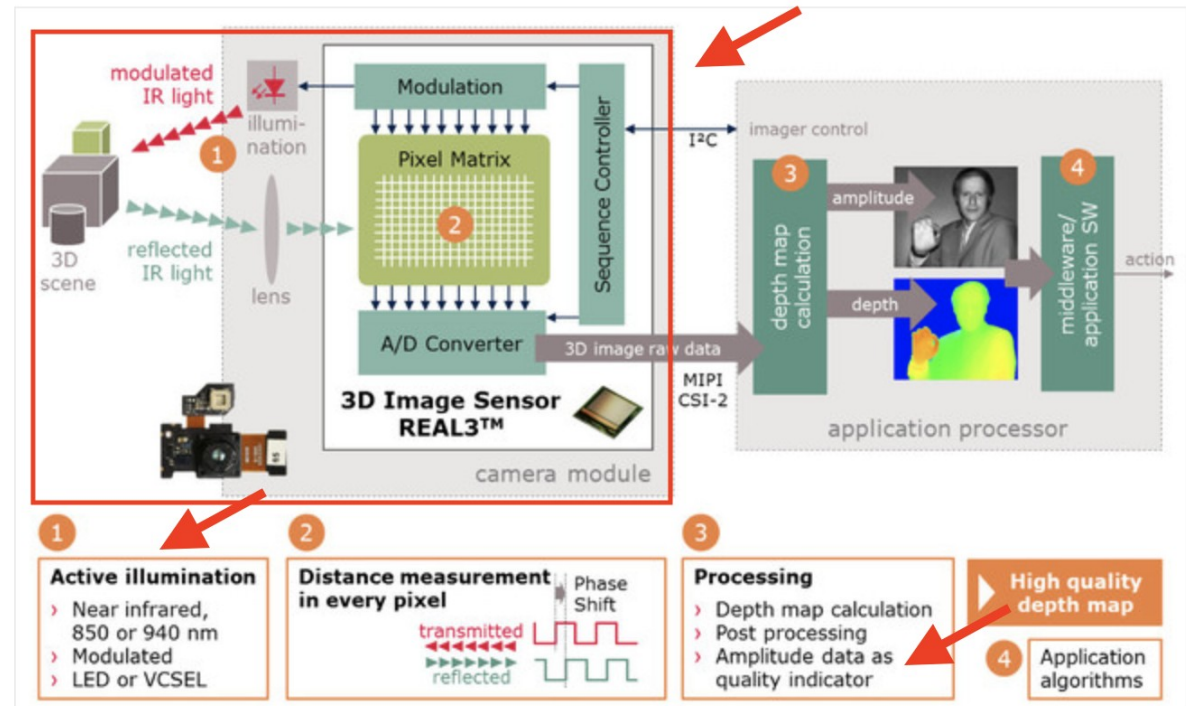
To take a photo with a gesture

1. Activate the front camera lens.
2. Raise your hand, with an open palm, until the front camera detects it (a box appears on the screen).
3. Make a fist to start a countdown before the shot is taken (allowing you time to position yourself).

[7]

	<p style="text-align: center;">LG G Pad 7.0^{LTE}</p> <p>press a volume key to take a photo </p> <ul style="list-style-type: none"> • <u>Gesture Shutter²</u> – take selfies with a simple hand gesture • Image Editor – choose from multiple options to enhance your photos such as adding filters and frames, adjusting contrast and brightness, and more • Video Resolutions: full HD up to 1920 x 1080¹ • Pause & Resume Recording – pause and start in record mode for one continuous video file • Live Shot – take still shots while recording video • Live Zooming – zoom in/out on videos during playback • Geotagging – include location information with photos and videos <p>¹ Available only on rear-facing camera or camcorder.</p> <p>² Available only on front-facing camera or camcorder. </p> <p>[3]</p>
<p>enabling the module for generating a signal representative of the electromagnetic radiation;</p>	<p>The LG mobile device enables the module to generate a signal that is representative of the electromagnetic radiation.</p> <p>For example, the time-of-flight sensor generates a signal responsive to the infrared electromagnetic radiation received from the location or subject at which the front-facing camera is pointed. The design and manufacture of the mobile device itself enables the time-of-flight sensor to generate the signal.</p>

	<h2>What is a time-of-flight camera? </h2> <ul style="list-style-type: none"> • Emits an infrared light signal • Measures how long the signal takes to return • Determines depth based on extracted data <p>A ToF camera uses infrared light (lasers invisible to human eyes) to determine depth information - a bit like how a bat senses its surroundings. The sensor emits a light signal, which hits the subject and returns to the sensor. The time it takes to bounce back is then measured and provides depth-mapping capabilities. This provides a huge advantage over other technologies, as it can accurately measure distances in a <u>complete scene with a single laser pulse</u>.</p> <p>[8]</p>
<p>enabling processing said signal to extract information related to intensity of the electromagnetic radiation in the selected location, and</p>	<p>The LG mobile device enables processing the signal to extract information related to intensity of the electromagnetic radiation in the selected location.</p> <p>For example, the main processor (CPU) in the mobile device processes the signal to extract information of the infrared electromagnetic radiation, in the location of the time-of-flight sensor or at which the camera is pointed. Both time delay and amplitude (intensity) of the reflected infrared electromagnetic radiation is measured. The amplitude is used as a quality indicator of the data obtained from the reflected IR electromagnetic radiation. The design and manufacture of the mobile device itself enables the SoC device to process the signal.</p>



Infineon's Time of Flight 3D Sensor. Click to enlarge

[4]

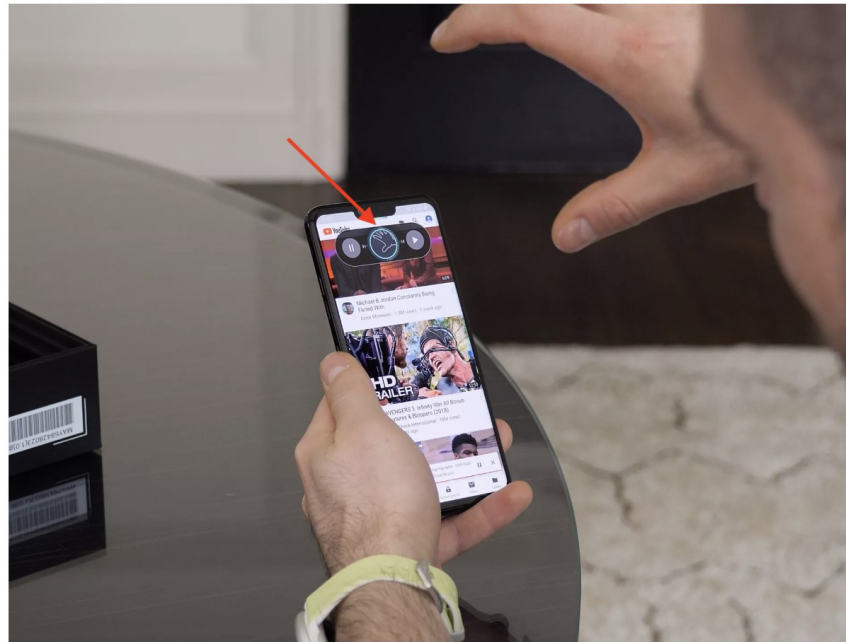
enabling sending said information to the output component for conveying the information to the operator.

The LG mobile device enables sending the information to the output component for conveying the information to the operator.

For example, when using the Air Motion feature of the G8 ThinQ smartphone, a hand guide appears on the display when the mobile device recognizes the hand gesture based on the processed information from the time-of-flight sensor. The design and manufacture of the mobile device itself enables the main processor (CPU) to send the information to the touchscreen display.


How to use Air Motion on the LG G8

By Hayato Huseman published April 12, 2019



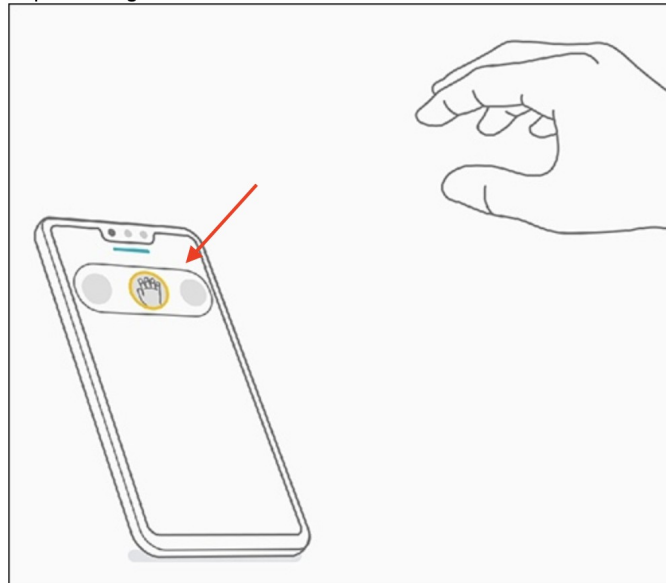
LG G8 Air Motion gestures (Image credit: Android Central)

[6]

- c. Wait for the 'hand guide' overlay to appear. 



- d. Swipe left or right.



[9]

For example, when using the Gesture Shot feature of the LG GPAD 7.0 LTE tablet, a box appears on the display when the mobile device recognizes the hand gesture based on the processed information from the time-of-flight sensor. The design and manufacture of the mobile device itself enables the main processor (CPU) to send the information to the touchscreen display.

Gesture shot

The Gesture shot feature allows you to take a picture with a hand gesture using the front camera.

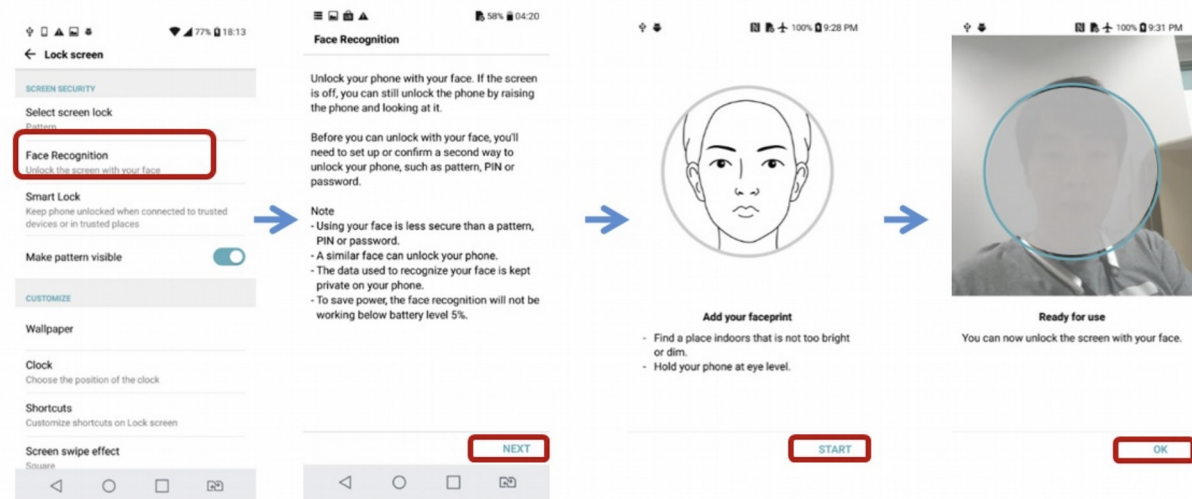
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[7]

For example, Face ID for unlocking displays a circle around the image of the user's face on the display after the respective faceprint has been registered. The design and manufacture of the mobile device itself enables the main processor (CPU) to send the information to the touchscreen display.

- ① Please adjust the front camera shot to eye level ensuring capturing the whole face.
- ② Follow the instructions on the screen to register your faceprint.
- ③ When faceprint registration is completed, press OK button.



[15]

Product List:

Smartphones: G8 ThinQ, G8 X ThinQ, V50 ThinQ

Tablets: G Pad X 8.0 (V520), G Pad 7.0 LTE (LGV411), LG G Pad™ III 8.0 FHD (LGV522), LG G Pad II™ 8.0 LTE (LGV497)

References:

[1] LG explains how the G8 ThinQ's tiny gesture sensor works

<https://www.engadget.com/2019-02-20-lg-g8-thinq-gesture-sensor-module.html>

[2] PhoneDB - LG LMG820QM5 G8 ThinQ TD-LTE US G820QM / LMG820QM7D (LG Alpha Prime)

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[3] LG G Pad 7.0 LTE

https://www.lg.com/ca_en/support/products/documents/eSpec_Sheet_LG_Gpad7.0_EN.pdf

[4] The Register - LG's new gesture UI for mobes ...

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[5] LG's G8 ThinQ lets you control it with a wave of your hand

<https://mashable.com/article/lg-g8-thinq-hands-on-air-gesture-controls-mwc-2019>

[6] How to use Air Motion on the LG G8

<https://www.androidcentral.com/how-use-air-motion-lg-g8>

[7] LG – Gesture Shot

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<https://www.verizon.com/support/knowledge-base-224624/>

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https://www.lg.com/ca_en/tablet/lg-LGV522

[11] LG G Pad II™ 8.0 LTE (LGV497)

https://www.lg.com/ca_en/tablet/lg-LGV497-lg-g-pad-8.0-lte

[12] LG G Pad 7.0 LTE (LGV411)

https://www.lg.com/ca_en/tablet/lg-LGV411

[13] Walmart - Verizon Unlocked LG G8 ThinQ Gray 128GB

<https://www.walmart.com/ip/Verzion-Unlocked-LG-G8-ThinQ-Gray-128GB-Grade-A-Condition/2498673685>

[14] Walmart - LG G Pad X V520 8in 32GB Blue Android Tablet (AT&T)

<https://www.walmart.com/ip/Restored-LG-G-Pad-X-V520-8in-32GB-Blue-Android-Tablet-AT-T-Grade-A-Refurbished/595095089>

[15] LG Face Recognition - Setting Up

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